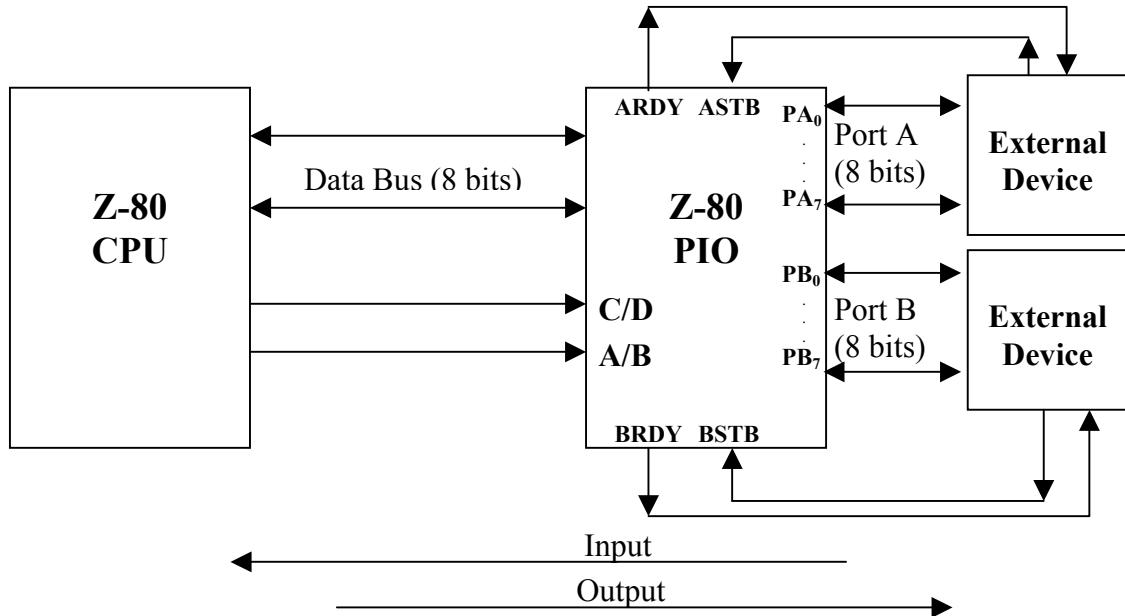


Z-80 PIO

Z-80 Parallel Input-Output unit is an IC which have two 8-bit parallel port to interface with the external devices. The details of the internal structure and the hardware connections of CPU and PIO will be explained in a later course and not included in this text.



The Z-80 PIO has two ports Port A and Port B. Each port has a data and a control register. The Data Registers are used to input or output the data while the control registers are used to define the operation of the related port. These registers will be called as PIOCRA, PIOCRB, PIODRA, PIODRB in this text, which mean control register A, control register B, data register A and data register B, respectively. These registers are selected by the CPU by changing the voltage level in C/D and A/B pins of PIO.

C/D	Logic “1”: Control Registers
	Logic “0”: Data Registers
A/B	Logic “1”: Register of Port A
	Logic “0”: Register of Port B

The Z-80 PIO should be programmed via CPU before using it in data transfer. For the programming, the control words are sent to the control registers of the PIO.

ARDY (Port A ready)(output-active high), ASTB (Port A strobe) (input-active low), BRDY(Port B Ready) (output-active high), BSTB (Port B strobe) (input-active low) pins are used for handshake signal in data input-output operations. The outputs show the status of the

data in the port data registers, while the input signals show the status of the data in the external device.

The ports of PIO has 4 operation modes

- Mode 0: Output Mode
- Mode 1: Input Mode
- Mode 2: Bidirectional Mode
- Mode 3: Bit Control Mode

Port A and Port B can be chosen to work in either of these modes except the mode 2, bidirectional mode. Only Port A can be used in bidirectional mode.

Mode 0

When one of the ports is selected to operate in Mode 0, all pins of this port is used to send the data to the external device (such as display, leds, printer etc.).

Mode 1

When one of the ports is selected to operate in Mode 1, all pins of this port is used to get the data from the external device (such as keypad, buttons etc.).

Mode 2

When Port A is selected to operate in Mode 2, all the pins of this port is used both to send to and get from the data from the external device. ARDY, AST pins are used for handshake signal in data output operation and BRDY, BSTB pins are used for handshake signal in data input operations. A logic “1” in ARDY output indicates that the data is ready in the port A output register. A logic “0” in ASTB input shows that the external device has successfully read the data. A logic “1” in BRDY output indicates that the port A is ready to get data. A logic “0” in BSTB input shows that the external device has sent the data.

Mode 3

When one of the ports is selected to operate in Mode 3, the pins of the port can be chosen as input or output individually.

Programming The Z-80 PIO

In order to program the Z-80 PIO some 8 bit control words should be sent to the control register of the related port. The last four bit of the word defines its operation and is called as word ID. This operation is accomplished by the “OUT” instruction

LD A, “control word”
OUT PIOCRA, A or OUT PIOCRB, A (only from A register)

The programming steps are stated below:

1. Select the operation mode

Mode Control Word							
M1	M0	X	X	1	1	1	1
Mode		Don't care			Word ID		

M1	M0	Mode
0	0	0 (output)
0	1	1 (input)
1	0	2 (bidirectional)
1	1	3 (bit-control)

2. If the bit control mode is selected, set the input and output bits by sending I/O control word.

I/O Control Word							
I/O ₇	I/O ₆	I/O ₅	I/O ₄	I/O ₃	I/O ₂	I/O ₁	I/O ₀
1: Input							
0: Output							

Send the interrupt control word if the input bits will generate an interrupt.

Interrupt Control Word							
EI	AND/OR	High/Low	Mask Follows	0	1	1	1

EI : Enable Interrupt =1 enable
= 0 disable

AND/OR = 1 all input bits should be active to generate interrupt
= 0 when one of the inputs is active, generates interrupt

High/Low = 1 active high (generates interrupt when the bit is 1)
= 0 active low (generates interrupt when the bit is 0)

Mask Follows =1 shows that the following word is a mask word which defines which of the input bits will generate interrupt.

Mask Word							
MB ₇	MB ₆	MB ₅	MB ₄	MB ₃	MB ₂	MB ₁	MB ₀
1: Masked (cannot generate interrupt)							
0: Non-masked (can generate interrupt)							

3. For all modes of the PIO, interrupts can be enabled or disable by interrupt control word. Interrupts are disabled as default.

Interrupt Control Word							
EI	X	X	X	0	0	1	1
EI = 1 Enable interrupt							
= 0 Disable interrupt							

After the programming is complete data can be send to or get from external device via PIO with “IN” and “OUT” instructions.

IN A, PIODRA or IN A, PIODRB ; Get the data from I/O port to A register
OUT PIODRA, A or OUT PIODRA, A ; Send the data from A register to I/O port